

Impact of Lean Practices on Printing Companies

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2010

ABSTRACT

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The purpose of this study was to bring understanding to what Lean and sustainable practices are most efficient and popular within printing companies. The information and data collected provides insight into what companies are doing to be Lean. The data exhibits what Lean and sustainable techniques that provide positive effects for companies and identifies potential pitfalls for why companies have not been able to be productive with Lean strategies.

This study collected and analyzed data on Lean and sustainability efficiency through historical case studies and descriptive research surveys. Case studies in the printing industry were studied and compared on the issues of Lean and sustainable practices used, time and monetary savings, and the increase in productivity. Thirty surveys were sent to printing companies throughout the California area. The respondents answered questions relating to the application of Lean and sustainable principals, the existence of a separate Lean department and coordinator, monetary savings, productivity increase, and interest of customers in the businesses Lean strategy.

Findings from the case studies reveal that using Lean techniques to solve issues within a printing company provide savings in time and money and a significant increase in productivity. Results from five responses indicated businesses with a separate Lean coordinator and department yielded positive effects, while business without a Lean manager were unable to produce positive results.

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Chapter I: Introduction

Lean management and sustainability have become two main trends businesses are focusing their resources on. Lean management and sustainability encompass the same focal point, reducing the amount of wasted resources in a company: using resources in a more productive way in order to sustain the resources that go into printing production processes. Physical resources to productivity and energy are encompassed under the domain of Lean. Lean refers to the entire enterprise from the shop floor, to the boardroom while including suppliers, partners, and customers. Businesses want to join the environmental movement since consumers are educated and becoming concerned with the impact they have on the environment. This environmental movement was first popular in the 1970's and is now gaining recognition once again. (Kessler).

Lean focuses on adding value to the customer's final product. Knowing what the customer values is the starting point. Then, the printing company must understand the company's process in order to deliver this value. Finally, understanding the process will enable waste to be removed by clearing out all non-value-added activities within the value stream. The customer will then be able to receive value print products on demand (Kessler).

It is vital today that printing companies apply Lean and sustainable practices throughout the workflow process. This project answers the research question, what Lean and sustainable methods are most productive in making a printing company run to its highest efficiency. Choices between recycled paper and virgin pulp paper have a direct effect on the sustainability of a print company. Where as, streamlining workflow and locating equipment closer to the necessary workstations will enhance productivity creating functional workspace. Lean techniques, such as reducing the amount of back inventory within a print company will decrease

wasted inventory that will potentially be unused. There are sustainable chemical choices to use in a printing company as well. Ink, press chemicals, such as blanket wash and fountain solution, the plate making process, and other chemicals used in a printing facility produce volatile organic compounds (VOCs). VOCs are “organic compound which reacts in the presence of sunlight, with nitrogen oxides (NO_x) to form ozone. Although ozone is needed in the upper atmosphere, in the lower atmosphere (near the earth’s surface) it acts as a lung irritant, causing health problems in people, animals and plants” (QGCPO). Switching to low VOC emission chemicals and alternatives to VOC products will significantly reduce VOCs emitted into the atmosphere, making for a more sustainable printing company. Simple Lean implementations can make a substantial positive difference to the workflow and efficiency of a printing company.

The graphic communication industry is a prime supporter of Lean practices. The business of printing has to deal with the problem of waste in numerous forms: paper, productivity, and resources. Consumers have started to demand sustainable made product and producers are answering these pleas. This project explores what Lean methods are being used within businesses and researching these methods to reveal the true productive value. Implemented Lean procedures have a positive impact, but is it helping the print company as much as originally thought? Companies may be applying Lean practices not knowing how efficiently they are working.

The purpose of this study was to research what Lean techniques have the most positive impact within the graphic communication print industry. The reader will know what it is to be a Lean print company. When Lean management and sustainability practices are implemented correctly, resources are used more efficiently. Consumers and producers want products with less wasted input leading to a Lean and effectively produced finished product.

Chapter II: Literature Review

One practice of Lean is the act of Lean management. Lean management focuses on making the use of all resources within a print company more efficient. These are physical

resources, such as paper, equipment, and employees as well as time, money, and energy that can be used ineffectively. This type of Lean management organizes the workplace and workflow in order to produce an efficient work environment and boost product quality. Lean also focuses the printing company towards leading a sustainable business life. A sustainable business uses materials and practices that are recycled or have a less harmful impact on the environment than other methods (Langenwalter).

“Lean techniques have helped Denver Health's doctors see more patients — mainly by eliminating paperwork and rearranging offices so that the physicians don't have to do as much walking. In just one clinic, such moves have generated an extra \$520,000 in revenue since 2007” (Hyatt). Part of Lean is reducing wasted movement and streamline motion. This is exactly what the doctors in Denver have done to cut unnecessary spending. Eliminating preventable paperwork that has to be done in a hospital, mainly by doctors, saves time and ultimately saves money. The time hospital employees put into avoidable paper work can then be put towards more beneficial work, such as seeing more patients. Saving time leads to saving a main resource, which is money (Hyatt).

The Mid-America Manufacturing Technology Center (MAMTC) is a not-for-profit organization in which, “experts bring unbiased recommendations and world-class techniques to manufacturing, printing, distribution and other companies throughout Kansas. MAMTC helps local businesses compete by implementing integrated process improvements that affect the entire value stream” (Benefits of Lean). It is reported in an article by MAMTC, “The Manufacturing Edge,” that through the process of implementing Lean management that work-in-progress could be reduced 60 percent to 80 percent by eliminating the problem of overproduction. Throughput, products from start to finish, can be increased 40 percent to 80 percent and productivity, final

output, 75 percent to 125 percent if applied correctly. MAMTC explains that using Lean techniques will significantly reduce waste while boosting productivity in a print company. Savings in all these areas lead to an overall upgrade in production for the company due to non-value-added activities being eliminated (Benefits of Lean).

Timothy Fuller, from the University of Wisconsin, author of “Eliminating Complexity from Work: Improving Productivity by enhancing Quality” explains that the use of Lean techniques improves quality without adding cost to the company. “Poor quality increases complexity which in turn increases cost. Improving quality reduces complexity, and higher productivity and lower cost follows” (Fuller). A non-Lean print company has high complexity within the workflow; therefore non-value added activities exist leading to wasted resources. Applying Lean methods will reduce this complexity issue allowing for a smooth process to evolve. This smooth process eliminates non-value added activities, which in turn reduces cost for a print company. The high costs are due to wasted resources within the workflow process from defects, work-in-progress, or left over inventory, which are then eliminated when Lean practices are put into place (Fuller).

One main area that Lean focuses on is 5S implementation in a print company. A 5S program is usually a part of, and the key component of establishing a visual workplace. The 5S's break down into sort, set in order, shine, standardize, and sustain. “This technique uses the idea that there is a place for everything where it can most efficiently be used” (McManus). Sort is the first step; sort through all resources and tools, keeping only the most essential. Set these essential resources in order where they will best be used in daily operation. There is a proper arrangement in order be easily accessible. Once there is a proper place for everything in the work areas, these areas must continually be kept Lean and in order. A Lean environment

inspires workers to produce quality work. Standardization involves producing work in a consistent and timely manner. The final step is to sustain this practice. The methods producing this area organization must be reviewed and maintained to remain efficient (McManus).

According to McManus, safety hazards can be reduced up to 70 percent along with 5 percent to 60 percent reduction of incorrectly used space and wasted motion by employees. Productivity in the work place can see a 15 percent to 50 percent or more positive increase. Using the 5S program to organizing the entire work area allows for employees to become more efficient and quality print products to reach consumers.

Flexographic label printing has seen improvements by incorporating the Lean philosophy. Throughput Solutions, a lean manufacturing training service, describes a situation in which a flexographic printing company was dealing with long changeover and setup times between product runs that were creating extended downtime. Buying additional equipment was being considered to prepare for a forecasted increase in demand. Quality defects and raw material waste issues that were also of great concern (Throughput Solutions).

Using the newly innovated method, Single Minute Exchange of Die (S.M.E.D.), the entire operation was reorganized and a procedure was created that minimized downtime. Setups and changeovers became well-timed events.

“The 5S organization techniques was heavily relied upon and ergonomic tools to properly place needed items and reduce risk of injury and operator fatigue. Quality defects were addressed by implementing a series of strategies for component maintenance and machine calibration. Raw material waste was also addressed through a "go, no go" procedure and a setup innovation” (Throughput Solutions).

The results of implementing the S.M.E.D. procedure lead to previous three to five hour setups or

changeovers being completed under 30 minutes regardless of complexity. This improvement meant there was no further need to purchase equipment to meet forecasted demand. Third shift employees were transferred to second shift and throughput increased. Approximately 25 percent less raw material waste became the standard for the company, and quality defects were greatly reduced. These improvements resulted in more than a \$3 million dollar annual profit increase without adding a single piece of equipment or additional employees (Throughput Solutions).

Another focus of Lean in a printing company is using sustainable resources. A physical element that significantly adds waste to a print company is paper. Paper can either be virgin pulp or recycled. There are also different sustainable choices within a printing company that use less harmful chemicals. When environmentally friendly chemicals are used in a printing company the harmful compounds released into the air and surrounding environment decrease. Reducing the amount of unsafe chemicals produced help the company lead a more sustainable practice (Ynostroza).

There are two main categories for paper, virgin pulp and recycled, with different treatments available for both. Virgin pulp paper “Coming directly from trees, it contains the strongest and purest fiber and requires the most energy to manufacture. It obviously has the most immediate impact on the forest” (Monadnock). Virgin paper has not undergone previous printing and is first-generation printed straight from the tree to the paper manufacturer. Harvesting virgin pulp is the least sustainable practice as much of the paper products turn into non-recycled waste in a landfill. When a company continually purchases virgin pulp paper for their print company there is no effort to participate in the “green” environmental movement. “A pallet of copier paper (20-lb. sheet weight, or 20#) contains 40 cartons and weighs 1 ton. Therefore, 1 carton (10 reams) of 100 percent virgin copier paper uses .6 trees” (Conservatree).

This means that one box of printer paper for the typical inkjet printer uses 60 percent of a tree to be produced with virgin pulp. In a business setting, boxes and reams of paper add up quickly (Conservatree).

Recycled paper, paper made from post-consumer waste, increases the overall lifecycle of a paper product. In comparison, “100 percent post-consumer copy paper, 1 ton (40 cases) saves the equivalent of: 24 trees [forty feet in height and 6-8 inches in diameter], 7,000 gallons of water, 4,100 kw hours of electricity, and 60 pounds of air pollution” (Conservatree). Therefore, 1 ton of 100 percent virgin pulp paper uses 24 trees, while 100 percent recycled post-consumer paper not only saves those 24 trees when recycled, but water, energy, and electricity as well.

According to research by the Alliance for Environmental Innovation, each ton of recycled fiber that displaces a ton of virgin fiber used in coated groundwood paper (magazine paper) can have a significant impact on the environment. The end result of recycled paper can reduce total energy consumption by 27 percent, net greenhouse gas emission by 47 percent, wastewater by 33 percent, solid waste by 54 percent, and wood use by 100 percent for each ton of recycled post-consumer paper. Implementing recycled paper is sustainable for the forest environment and reduces wasted energy emissions in the form of water, greenhouse gasses, and energy consumption in the production process of virgin pulp (Conservatree).

The chemicals used in a printing company are another area for the business to follow a sustainable practice. These chemicals are most often found in inks, press chemicals, commonly wash-up solutions and fountain solutions, and plate making processes. Volatile organic compounds (VOCs) are produced when these chemicals are used in the printing facility. Volatile organic compounds are “compounds that have a high vapor pressure and low water solubility” (Volatile Organic Compounds in Printing). VOCs have been found to be a major contributing

factor to ozone, a common air pollutant that has been proven to be a public health hazard and a highly reactive gas that affects the normal function of the lung in many healthy humans (Volatile Organic Compounds in Printing).

Wash-up chemicals used for blanket and roller Leaning common VOC emitters in a printing company. According to the case study, *Emission Reduction in Waterless Printing Operations*, the amount of cleanup solution used annually decrease significantly when the company, WinCup, Inc., switched from an isopropyl alcohol (IPA) based Leaning solution to Danko Industries' Wash-Up Evap A. Productivity was also declining because WinCup, Inc. was exceeding their environmental emissions permit limits due to the use of high emitting VOC chemicals.

“Based on the 1997 purchase records for the West Chicago, Illinois plant, WinCup was using approximately 8633 lbs per year of isopropyl alcohol. This generated approximately 4.32 tons of VOC emissions per year. Due to air emissions permit limitations WinCup was forced to limit their production and Leaning activities while using IPA. By switching to Wash-up Evap A the company was able to reduce VOC emissions from press Leaning activities by 66 percent (approximately 2.85 tons VOC) and improve worker safety. This reduction also created an opportunity to increase production without the concern of exceeding their air emission permit limits. WinCup estimates they have been able to produce 550 lbs more material for every 1 gallon of IPA they eliminated (based on emission factor)” (Emission Reduction).

Table 1.0 shows the difference between Wash-Up Evap A solution versus IPA solution.

Switching to Wash-Up Evap A allowed WinCup to decrease annual VOC emissions by 66 percent.

	VOC Content	HAP Content	Vapor Pressure	Flash Point	Annual Usage
Wash-Up Evap A	100%	None	8.3 mm Hg @ 20 C	143 F	7 Drums or 385 gal
IPA	100%	None	33 mm Hg @ 20 C	54 F	24 Drums or 1320 gal

Table 1.0

The Printing Industries Association of Australia published the report, “Reducing VOC solvent use in the Printing Industry,” explaining that most wash-up solutions and press solvents contain about 40 percent to 50 percent Isopropyl Alcohol (IPA). Due to the high alcohol content, the actual Leaning agent in the solution evaporates before the Leaning function is accomplished.

“IPA substitutes and reducers have proved to be just as effective, but more economical in use since almost 100 percent of the substance performs the work it is intended to do.

Added to this is the greatly reduced risk of fire due to the higher flashpoints of non-VOC chemistry, leading to low insurance premiums” (Reducing VOC Solvent).

According to this report, the higher the alcohol content in solutions and chemicals the faster the evaporation rate. Therefore, leading to the organic compounds being distributed into the environment at a more rapid pace making these solutions high VOC emitting products (Reducing VOC Solvent).

Producing imaged plates for printing presses is another area that emits VOCs within a printing company and threatens the sustainability of a business. The previous most common way to create a printing plate was to use a negative to serve as the stencil for the printing plate. The negative, which is chemically developed, is washed in chemicals and solvents before a single

plate is even developed. The resulting negative was then used to produce a plate, which requires further chemical. The process of using a negative to create a plate is an unnecessary waste of chemicals that release VOCs (Direct Imaging Technology).

To eliminate this waste of materials and become a sustainable working company, the new process of Computer to Plate Imaging was developed (CTP). CTP is a Direct Imaging Technology, which focuses on environmentally responsible printing processes by doing away with the chemicals used for plate making. The production of printing plates goes directly from the computer, without requiring film as an intermediate step, then to the plate onto the press. This direct imaging technology saves prepress make-ready time, improves quality, and eliminates the need to use and purchase chemicals to produce imaged plates that were previously used when plates solely were made from film negatives making CTP imaging a sustainable and Lean practice (Computer to Plate).

Another Lean and sustainable practice is applying the use of environmentally responsible inks in a printing company. The three main components of offset ink for sheetfed printing are pigment, a vehicle, and additives. “Pigments give the inks their colors and a vehicle is a moist substance, such as petroleum, water, soy or other vegetable oils, that eases the spread of pigments and provides more even color. Additives, such as waxes and distillates, help reduce set off and improve the ink’s performance on press” (Lenz).

Current regulations require that petroleum based inks release no more than 30 percent VOCs. Petroleum inks are not only made from a non-renewable resource, but they release as much as 30 percent VOCs into the environment as they dry. Petroleum based inks are no longer the only option for consumers. Vegetable based inks can be an effective alternative in decrease the amount of dangerous VOCs released (Lenz).

Vegetable based inks are made of a mixture of renewable resources, such as soy, flax, canola or safflower. Using the renewable resources reduces VOC emissions to two to 15 percent down from 30 percent with petroleum inks. “Even though petroleum based inks produce a sharper dot, vegetable based inks have a much better ink holdout, less dry back, and as long as slightly added dot gain is allowed for in prepress, results will be just as vibrant, if not better” (Lenz).

The background research on the topic of Lean and sustainability reveals that the philosophy of Lean is a positive practice in the printing industry. Using the tools of Lean and leading a sustainable printing company provide substantial positive impact on the business. Organizing the workflow with Lean techniques to eliminate waste from the process workflow within a printing company along with choosing sustainable practices such as, recycled paper and press chemicals that emit none to low VOCs will increase profits along with productivity.

Chapter III: Research Methods and Procedures

Printing businesses are continually looking for ways to conserve resources. Eliminating wasted resources is exactly what the Lean philosophy will do for a printing company. The Lean practices currently used in printing businesses were surveyed and researched in order for the most efficient methods to be put in place.

To study the impact of Lean practices within printing companies, this project used the methods of descriptive research, historical research, and content analysis. Descriptive research is designed to answer the questions of who, what, when, where, and why. This method analyzes the characteristics of data collected through case studies, surveys, trend analysis, documentary analysis, developmental studies, and correlation studies (Levenson 24). Descriptive research attempts to identify the cause of something that is or was happening. It attempts to describe what exists in a situation (Key).

Historical research allows one to “look into the past to predict the future” (Levenson 24). This research process is used to understand the background of a company in order to offer insight into organizational culture, current trends, and future possibilities. Both quantitative and

qualitative variables can be used to collect historical research information. Through the detailed analysis of historical data and descriptive research, cause and effect relationships can be determined (Key).

Content analysis research is applied to examine any piece of writing or occurrence of recorded communication (Stemler). Content Analysis is used to take the qualitative data found through the case studies and surveys quantitative data. The data is put into numerical form for analysis and comparison. This allows for developing results and drawing conclusions on the topic. Content analysis techniques retrieved data that explains the positive impact of Lean practices on a printing company.

For the purpose of this project, descriptive research was used through surveys and case studies. “Surveys gather relatively limited data from a relatively large number of cases. Typically, they attempt to measure what exists without questioning the reasons for existence” (Levenson 25). The type of survey that was used is a sampling of tangibles. This type of survey uses samples of the population to make inferences about this same population. In order to make a sample of survey tangibles valuable, the sampling procedure must be appropriate, the data collection method needs to be accurate, and the information obtained to answer the questions of the study must be relevant (Levenson 25).

The survey answers the question; what impact does Lean have on a print company? This purpose of this project was to collect data on Lean techniques revealing what Lean practices are most efficient for a print company. The survey gives a general focus of the most popular practices that are used in the current printing industry. This shows what Lean procedures print companies are actually implementing.

The descriptive survey was sent to printing companies ranging from small to large in the state of California that produce the most common printing styles of offset lithography, flexography, digital, web, gravure, and screen printing. It was distributed via letter mail and electronically through e-mail to the company. The company was researched before the survey was distributed in order to decide the appropriate person for the survey to be addressed to. The survey was addressed to the production manager unless the printing company has a Lean department then the survey will be addressed in particular to the Lean manager. The list of companies the survey was sent to is attached in Appendix A.

The introduction of the survey had an explanation of why the printing company is receiving this survey. It also explained what Lean and sustainability are within a printing facility as to ensure that all who received the survey used the same definitions for answering the questions. This introduction will provided the overview for the purpose of this survey study.

The questions on the survey are as follows:

1. What type of printing does your company produce?
 - a. Offset lithography
 - b. Digital
 - c. Gravure or Engraving
 - d. Flexography
 - e. Screen printing
 - f. Web
 - g. Other _____
2. Does your company have a designated Lean coordinator?

- a. Yes
 - b. No
3. Does your company implement Lean or sustainability techniques?
- a. Yes
 - b. No
4. If so, what are the most influential and efficient methods of Lean or sustainability that are used and how long in years have they been in place?
- a. Recycled paper _____
 - b. 5S's (sort, set in order, shine, standardize, and sustain) _____
 - c. Process Mapping/Value Stream Mapping _____
 - d. Just in Time Inventory system _____
 - e. Total Quality Management _____
 - f. Kanbans _____
 - g. Six Sigma _____
 - h. Push System _____
 - i. Pull System _____
 - j. Water based inks _____
 - k. Vegetable based inks _____
 - l. Computer to Plate imaging _____
 - m. UV based Inks _____
 - n. Other _____
5. What area(s) of Lean does your company devote most time and effort to build and implement?

- a. _____
 - b. _____
 - c. _____
6. Has your company seen monetary savings since implementing these practices?
- a. Yes
 - b. No
7. If “yes” was answered to #5, what monetary range did these practices help your company save per year?
- a. \$0 to \$15,000
 - b. \$15,000 to \$30,000
 - c. \$30,000 to \$70,000
 - d. \$70,000 to \$100,000
 - e. \$100,000 to \$500,000
 - f. \$500,000 to \$1Million
 - g. \$1 Million +
8. Has your company seen improvements in productivity by implementing these practices?
- a. Yes
 - b. No
9. How much did productivity increase?
- a. 0% to 10%
 - b. 10% to 20%
 - c. 20% to 30%
 - d. 30% to 40%

- e. 40% to 50%
- f. 50% to 60%
- g. 60% to 70%
- h. 70% +

10. Has your company seen an increased interest in the Lean practices of your company from your customers? Choose interest on the scale from 1 to 5.

- a. 1- Very interested
- b. 2- Interested
- c. 3- Slightly interested
- d. 4-Indifferent
- e. 5- Not interested

Using historical research case studies from Throughput Solutions provide examples of Lean within printing companies. Case studies are used to “understand the reasons that an individual or a group does what it does and how behavior changes in response to the environment” (Levenson 24). Case studies “provide an opportunity for an investigator to develop insights into basic aspects of human behavior” (Levenson 25). Case studies from Throughput Solutions provide examples of Lean within printing companies. Historical case studies provide data from controlled testing situations concerning Lean techniques within the print industry. The data from the case study *Flexographic Label Printing* describes Lean solutions that allow for shorter changeover and setup times from one job to the next. Another historical Lean case study, *Newspaper Aims to Improve Printing: A TQM Case Study*, was conducted by a newspaper in India to improve the quality of printing of its newspaper for success and survival. The case studies were used to collect data on money and time saved by using Lean

techniques and the increase in productivity, while providing insight into the effectiveness of Lean processes within a printing company.

The data gathered from descriptive research surveys was analyzed through content analysis. The survey questions were put into separate graphical charts with the answers assigned a numerical value. The Lean technique, duration of use, productivity percent increase, and the monetary savings will be compared through the charts. The answers that were chosen on the survey are quantified visually within these charts to show which answers were most popular and checking to see if these methods were of highest efficiency.

Content analysis of the historical case studies compared the key factors of how much money and time was saved and the increase in production or quality. The data was viewed within a matrix chart to visual comparisons on the same topic. Content analysis allows data to become quantitative in order to more easily compare Lean methods in a printing business.

Chapter IV: Results

Descriptive research surveys and historical case studies were used in order to gather data on the topic of Lean efficiency and sustainability in a printing company. The focus of the research and data collection is to reveal the popularity of Lean and sustainability versus the true implementation efficiency. There were twenty surveys sent through the paper United States Postal Service (USPS) and the same twenty electronically through e-mail. Of the twenty sent to printing companies through the USPS, zero replied while three companies replied by e-mail. Analysis of the survey results are discussed further in this chapter. Additionally, the historical data case studies: *Flexographic Label Printing*; and *Newspaper Aims to Improve Printing: A TQM Case Study*, were able to show how much money was saved, how much time was saved, and the increase in production using specific Lean techniques. The companies reported on the savings in time, money, and productivity or quality that was absorbed from each technique.

Case Study: *Flexographic Label Printing*

The flexographic label printing company was struggling with the process of die changeovers between jobs. On average the changeover took about 5 hours and could reach 7 hours depending on the job complexity. That is an average of 5 hours of press downtime. Thus, decreasing productivity while causing loss of profits during the press downtime.

Along with the techniques of 5S (sort, set in order, shine, standardize, sustain) and ergonomic tools, Throughput Solutions designed a Single Minute Exchange of Die process

(S.M.E.D.). S.M.E.D. is the “Lean tool used to create very fast changeovers and setups that greatly reduce machine downtime and increase throughput. It is common to reduce machine changeover times from hours to less than ten minutes” (“Flexographic Label Printing”). After implementing the new procedures all setups and changeovers were completed in less than 30 minutes regardless of complexity. This improvement eliminated the need to purchase equipment to meet predicted demand and the third shift employees were brought to second shift increasing throughput and quality.

This S.M.E.D. changeover technique was applied to six more machines in the pressroom (seven machines total). Each of the seven machines experienced an increase of about 5 hours per shift of additional running time, resulting in an additional 70 hours of productivity per day. These improvements resulted in more than a \$3 million dollar annual savings without adding a single piece of new equipment or additional employees. The results are displayed in the matrix below.

Case Study: Newspaper Aims to Improve Printing: A TQM Case Study

In the case study, *Newspaper Aims to Improve Printing: A TQM Case Study*, the newspaper company was dealing with a poor quality issue costing them lost time and money. The problem was defined as having blurred picture outlines and the shade and intensity of colors were not true to the originals. The newspaper company saw the quality deteriorating continuously on the product causing added time for new print runs and lost profits in sales.

To overcome this problem, they implemented Total Quality Management (TQM) using a Five Why Analysis and a process to sustain imputed standardization. TQM is set of management practices in an organization focused on consistently meeting or exceeding customer

requirements. TQM places strong emphasis on process measurement and controls as means of continuous improvement (Arumugam and Goyal). Five Why Analysis guides the TQM team to ask five why questions that relate to the problem. The Five Why questions lead the team towards the root cause of the problem (Steven Bonacorsi).

The process began with a Five Why analysis to determine the root cause of the blurred picture outlines. Below is the analysis diagram from the case study.

Why is the picture blurred? The four colors are not getting superimposed exactly one on top of the other.

Why? The printing cylinder plates are not accurately registered on the printing machine rollers.

Why? The locating notches on the plate are not accurate enough.

Why? Plate registration on the notching machine is inaccurate.

Why? The plate-making machine had two stations. In the first station, the print impression was transferred onto the plate while the plate was referenced by the three pins using the base and the left edges of the plate. On Station 2, the same plate was notched using the base and the right edge. This led to a different positioning of the notches with respect to the print on each plate. Because each color had one plate, the images were not superimposing exactly one on top of the other – leading to a blurred outline.

(Arumugam and Goyal)

The team then generated a procedure to countermeasure the offset placement of the plates. It was decided to “shift the roller on Station 2 from right of the plate to left of the plate. They tested the idea, and images with consistently sharp outlines resulted, resolving the problem. From this point, regular production went ahead smoothly and the change was internalized and documented” (Arumugam and Goyal).

The next step was to improve color accuracy. The case study explains that a density checking station was available at the printing station, but was unused because it was considered too cumbersome. The team took sample readings of black dots as a special exercise to define the current state of the process. The average density reading of the black color was 1.23. “The

desired range was between 1.05 and 1.15 print density, with an average of 1.1 print density. At that time, 90 percent of the dots were outside the desired range” (Arumugam and Goyal). The team set an initial target to reduce the number of dots outside the range by 50 percent.

Sample data on the variance of density dots from page to page constituted for more 90 percent of the color problem. The team encountered the problem of visual density checks taking place on the press rather than using the density readers. To check this idea, the team first set the machine using the existing method, and then by measuring the dots and adjusting the settings. The goal density reading was 1.1. The visual method read the desired density as 1.05, while using the density equipment provided the correct color match of 1.1.

The team then instituted a process of measuring the intensity regularly and adjusting the ink flow only if necessary. There were several similar problems detected through the control chart and worked to eliminate them. The sigma (difference in the variation of dot density) had gone from .064 to .033, about a 50 percent difference. “With the average set at the standard 1.1 print density, only 13 percent of the points were now outside the standard range – significantly better than the target of 45 percent” (Arumugam and Goyal). The team then implemented a daily routine of plotting the density on a control chart. The control chart showed that the set state for the press was achieved more quickly. This was due to the systematic system now used to determine ink density.

There was significant cost and waste savings along with the more efficient ink density control system. There was a 1.8 percent in waste savings and \$140,000 annual monetary savings that occurred.

The matrix below displays the techniques used in each case study along with the time, monetary, and productivity or quality savings.

	Technique(s)	Time saved	Monetary Savings	Productivity or quality Savings
<i>Flexographic Label Printing</i>	<ul style="list-style-type: none"> • Single Minute Exchange of Die • 5S • Ergonomic tools 	4.5 hours on average	\$3 million annually	Gained 5 hours of productivity per shift per machine on average (about 70 hours per day)
<i>Newspaper Aims to Improve Printing</i>	<ul style="list-style-type: none"> • Total Quality Management • 5 Why analysis • Sustain standardization 	50 percent from October to April. Machine reached set print stage 50 percent faster.	\$140,000 annually	2 percent increase in quality

Table 2.0

Survey

Of the twenty surveys that were sent to printing companies electronically by e-mail using surveymonkey.com, three companies responded (n=3). The physical surveys using the USPS generated zero responses. Although this is a small sample population to draw conclusive conclusions, ideas and similarities can be discussed. A copy of the survey is located in Chapter 3.

The respondents of the descriptive research surveys offer multiple choices for printing: offset lithography, flexography, digital, web, and screen printing. Offset lithography and digital held the majority of the printing options with 100 percent offering offset and 66.7 percent offering digital.

The descriptive research surveys revealed that 100 percent of the respondents believe that they implement Lean and Sustainable practices, while only 33 percent have a designated Lean coordinator. The replies claim, with one respondent neglecting to answer this question, that the most popular methods in place are 5S, process mapping/value stream mapping, Just-in-Time Inventory System, Total Quality Management, Six Sigma, kanbans, and push and pull inventory systems (see Figure 1.0).

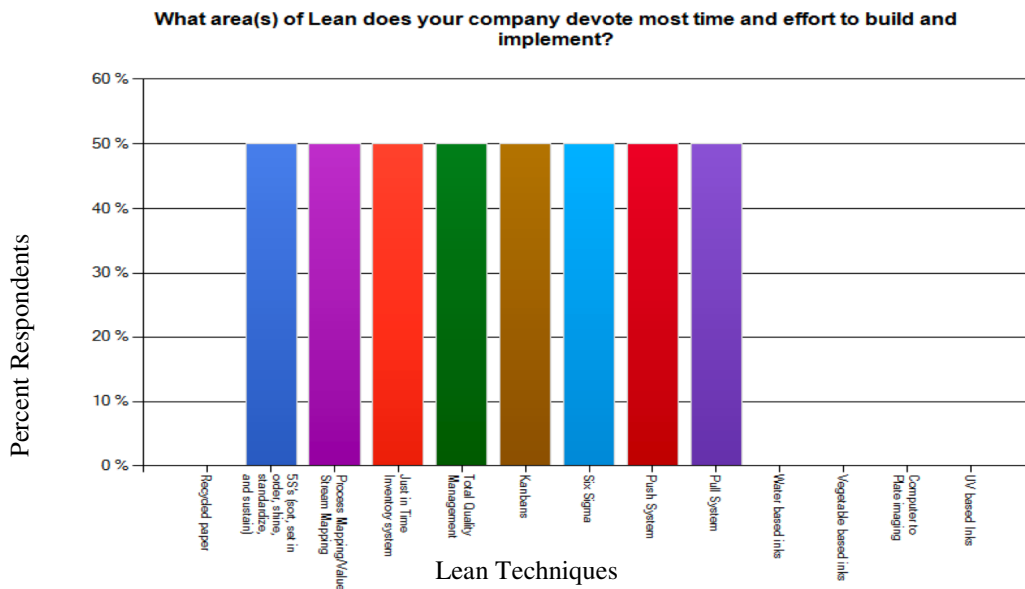


Figure 1.0

Figure 1.0 displays what Lean practices are most popular. One e-mail respondent declined to answer this question; therefore the answers are only for two respondents. Each colored bar represents a Lean technique that was chosen as an answer. The bars reach the level of 50 percent because only one company of the two chose that method.

Although 100 percent of companies responded yes to implementing Lean and sustainable techniques, only 33 percent declared monetary savings and productivity increase from the Lean processes (shown Figure 2.0). That is contradictory of what Lean is designed to do. This 33 percent of monetary savings and productivity increase coincides with 33 percent of the companies having a designated Lean director. As each survey was reviewed, the companies that responded yes to having a Lean coordinator also benefited from savings and productivity increase. The productivity was rated at an average of 30 percent to 40 percent increase with a

savings of \$1 million for the company.

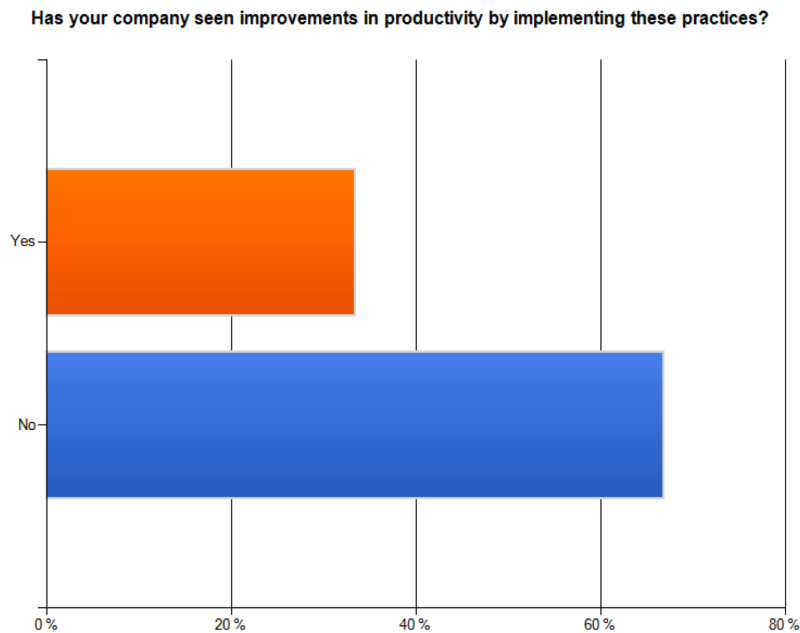


Figure 2.0

The survey revealed that companies have customers that are interested in the Lean and sustainability movement. Using this as a strategy, promoting Lean and sustainability to consumers, who are becoming more knowledgeable, can give a business a more competitive edge. Promoting the efficiency of their workflow will show the customer that they are conducting business with a company that is looking out for them as a valued customer. The customer will see the value that the Lean business can add to their product.

The analysis of the survey data reveals that while many companies may claim to lead a Lean and sustainable business that is not the case. The companies without a designated Lean coordinator have generated less favorable results. In these businesses, Lean has not added value and therefore has not been applied correctly. The other portion of the companies that have

implemented Lean through a particular leader and department have been able to add value to the business by saving time and money and increasing productivity.

Chapter V: Conclusions

From the research, data collection, and data analysis, Lean and sustainable methods have shown to add a positive influence to printing companies. The most common Lean and sustainable techniques found to be used through the historical case studies and descriptive

research surveys are: 5S; process mapping/value stream mapping; Just-in-Time Inventory System; Total Quality Management; kanbans, and push-and-pull inventory systems.

Lean and sustainability allows a company to better use their resources. In the case of Flexographic Label Printing, the company was able use their own equipment and combining it with Lean methods to speed up the changeover and setup process on the presses. The newspaper company was able to find appropriate ways to fix their issues of blurred images and color variation using Lean methods. They were able to use their press equipment more efficiently and produce higher quality products. Lean helps companies find ways to better use their tools to suit the workflow.

The surveys uncover the fact that while companies may say they are imposing Lean within their workflow, it may not be making positive reactions. Lean needs to be fully integrated into the workflow in order for proactive results to be seen. Companies that are in this position do not designate Lean as a specific continuous improvement department. Lean is a full process that requires updating to keep up with the business workflow. The analysis of the data strongly suggests that in order to achieve continuous improvement, Lean should be a separate department integrated into the process workflow. The companies that indicated a distinct Lean and sustainability manager had the most positive and productive results.

Before responses were collected, it was thought that recycling would be a top contender for a popular Lean and sustainability method. Once the results were tallied, recycling was not in the category of most popular Lean and sustainability practices. This is surprising since paper is the main resource for a printing company, with paper being highly recyclable. “70 percent less energy is required to recycle paper compared with making it from raw materials” (International nature Conservation).

As companies save by eliminating waste (physical materials and labor) and using less of materials, the savings go straight to the bottom line of a company's earnings. Lean minimizes the overhead fixed costs and reduces operational cost raising the competitiveness of a company("Lean Manufacturing Techniques"). For example, the survey respondents that used the most popular Lean and sustainability methods added \$1 million to their earnings without adding any new equipment. When Lean methodology is used correctly it can add significant positive effects to a companies workflow and financials.

This project was designed to find the top Lean and sustainable trends within printing companies in California. In order to achieve results, historical case studies and descriptive research surveys were studied and analyzed. Many case studies were reviewed that dealt in the printing industry and two were chosen that applied Lean and sustainable practices in order to solve a problem that was common among printers. The two problems that were addressed were long changeover and setup times along with blurred images and color accuracy.

Implications For Further Research or Study

The physical surveys first constructed and sent out to the initial companies were cumbersome and generated zero results. Because of the time frame required to complete the research, the surveys had to be compiled digitally using Surveymonkey.com and sent through e-mail to the same printing companies. At this stage surveys were answered and data was collected.

In the future, students who choose to use surveys as a data collection method want to consider the fact that companies are not to be solely relied upon to gather information and data. They are busy running the day-to-day business of their company and may not want to divulge information to a student. Originally it was believed that companies would be more helpful in the

survey data collection, but that was not the end result. Having the project depend on the data from businesses that were slow to respond let the project fall behind schedule. Interviews to Lean and sustainable managers within a printing company would have been more productive. Interviews could have been conducted all on one day and responses analyzed earlier in the process of the project.

The topic of Lean and sustainability are in future of business. Consumers are becoming more knowledgeable and interested in Lean and sustainability, as the options are made available to customers. Future projects can expand upon this topic by researching the challenges within a printing company to applying Lean and sustainability principals. It is not enough for a company to know the theories behind Lean and sustainability. They need to know how to implement then in their company. Being Lean involves change and not all employees and processes are going to be easily converted to the Lean process. The challenges that are faced and overcome can be studied and put to use in other businesses facing similar problems.

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Appendix A: Contact List

Almaden Press	2549 Scott Boulevard □ Santa Clara, CA 95050
Poor Richards Press	2224 Beebee Street □ San Luis Obispo, CA 93401
V3 printing	200 North Elevar Street, Oxnard, CA Pacific
Pacific Southwest Container	4530 Leckron Road Modesto, CA 95357-0518

California Flexo, Inc.	6942 Ed Perkic Street, Riverside, CA
Packaging Arts	700 Walnut Ave. Mare Island, CA 94592
Lithotype	333 Point San Bruno Blvd. So. San Francisco, CA 94080
Printing By Design□	13078 Mindanao Way #212□Marina Del Rey, CA 90292
Coastline Printing	2885 S. Higuera San Luis Obispo, CA 93401
VIP Litho	780 Bwy St Redwood City, CA, 94063
Orange County Printing	2485 Da Vinci Irvine, CA 92614-5844
Anderson Printing	3550 Tyburn Street Los Angeles, CA 90065
Dome Printing	340 Commerce Circle Sacramento, CA 95815
M M Printing	1011 9th ST,□Sacramento CA 95814
IPS Printing	2020 K Street Sacramento, CA 95811
Action Printing	3343 Arden Way Sacramento , CA 95825
Mc Clatchy Co.	2100 Q Street Sacramento, CA 95816
Sutter Printing□	1103 North B Street Sacramento, CA 95811
DPI Printing	645 Mariposa Street San Francisco, CA 94107
Burns & Associates Fine Printing□	183 Jordan Avenue□San Francisco, CA 94118